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PROVISIONAL SPECIFICATION.

Improvements in Liquid Evaporating Apparatus.

I, ALFRED CHAPMAN, of 17, York Street, Liverpool, in the County of Lancaster, Engineer, do hereby declare the nature of this invention to be as follows:—

This invention has reference to apparatus for evaporating liquids, such as for
5 concentrating liquids; and it relates more particularly to that type of apparatus wherein the steam or vapour given off from the liquid being evaporated and concentrated, or some of it, is compressed by a steam jet apparatus, and its temperature raised; and such compressed steam, together with the steam used as the motor liquid of the jet apparatus, is utilized to heat and evaporate further
10 liquid.

In the following description of apparatus for evaporating liquid, the improvements hereunder are comprised.

The evaporating vessel, whether in a single effect, or a multiple effect arrangement, will be assumed to be of the vertical type, having a nest of tubes
15 within it, say at its lower part, connected at their lower and upper ends to two plates, and to the outside surface of which the heating steam is applied; whilst the liquid lies in the lower part, and passes through the tubes.

Within the evaporating vessel, and connected with the upper tube plate on it, the steam jet forcing apparatus of the kind referred to, or a plurality of
20 same, is or are employed, and supplied with motor steam of high pressure from outside, so that the whole of this jet apparatus is surrounded with steam or steam and liquid, and the inlet of the jet apparatus at the upper part is in direct communication with the steam space of the apparatus, and steam therein; and it is directly forced from the steam space by the end of the apparatus into
25 the heating space, surrounding the heating tubes of the apparatus or evaporator.

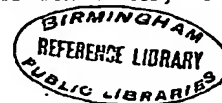
By this arrangement and mode of operating, no loss of heat or temperature of the steam of low pressure which exists in the steam space can take place, as no cooling of it can take place; and it is compressed and its temperature raised by means of the jet apparatus, say, to that equivalent to 3, 4, or 5 lbs.
30 above atmospheric pressure, or to a pressure above that existing in the steam space from which it takes its steam.

The compressor, that is the jet apparatus, may consist of a simple coned inlet, and a mixing and a diverging outlet part of suitable proportions; and the head may be a simple case or cage with openings for the inlet of steam. Or,
35 the inlet may be an open one entirely, and the steam led to the nozzle by a pipe from outside, where the motor steam regulating cock would be employed, so that there would be no working parts within the apparatus.

This apparatus would draw off and compress a part of the steam evaporated, which would be used over again as stated for evaporating other liquid; and
40 the remainder of the steam generated would be passed to a heater, to which the liquid to be evaporated is passed, and so pre-heated.

In evaporating sea-water for making fresh water from sea water, in cases.

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Chapman's Improvements in Liquid Evaporating Apparatus.

where the differences of pressure between the heating steam and the liquid being evaporated are small, it is necessary, in order that the apparatus and system may work properly, that the liquid, namely, the salt water, is not concentrated beyond a certain amount, and therefore, a certain quantity has to be continuously discharged, and this quantity in such a case, is large.

The heat of this liquid is recovered to some extent by heating the water to be evaporated, and this is done within a separate heater; whilst also a further heater can be employed for heating the water by the water resulting from the condensation of the heating steam; and these heaters, which may be of any known suitable kind, may be arranged and adapted to work in series.

In the case of the evaporating apparatus being horizontal or an inclined type, the jet apparatus will be placed in a steam space or chamber or a dome, on the same; and it might be either vertically disposed as in the former case described, or horizontal, or in any other position, discharging its steam directly into the space in which the liquid is heated; and in the case of a large apparatus, generally, a plurality of jet apparatus would be employed, instead of a large single one.

Dated this 24th day of July, 1913.

E. R. ROYSTON & Co.,
Applicant's Patent Agents,
Tower Building, Water Street, Liverpool, and
265, Strand, London, W.C.

COMPLETE SPECIFICATION.

Improvements in Liquid Evaporating Apparatus.

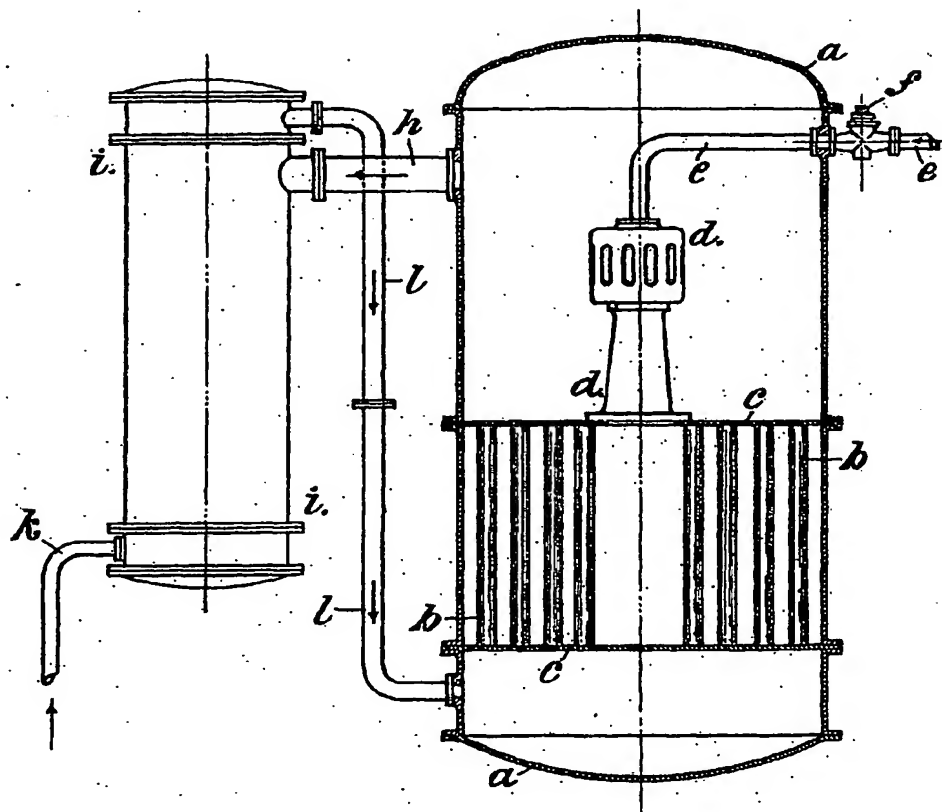
I, ALFRED CHAPMAN, of 17, York Street, Liverpool, in the County of Lancaster, Engineer, do hereby declare the nature of this invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention has reference to apparatus for evaporating liquids, such as for concentrating liquids; and it relates more particularly to that type of apparatus wherein the steam or vapour given off from the liquid being evaporated and concentrated, or some of it, is compressed by a steam jet apparatus within the steam space of the apparatus, and its temperature raised; and such compressed steam, together with the steam used as the motor of the jet apparatus, is utilized to heat and evaporate further liquid; and this invention consists of the particular arrangement of parts shewn in and set forth with reference to the drawing, namely, the heating space into which the compound steam is introduced consisting of a cylinder of the full diameter of the whole vessel, and lying between upper and lower tube plates in which the ends of the heating tubes are fixed; the steam jet compressor placed on this upper tube plate; a liquid chamber below the lower tube plate, and the liquid chamber and steam space above the upper tube plate. The steam jet compressor thus delivers directly into the centre of the heating chamber, and heats the vertical heating tubes which extend through it; and the liquid from the lower liquid chamber passes through these tubes into the upper chamber, in the steam space of which the head of the steam jet compressor stands.

The drawing shows the apparatus in vertical section.

a represents the evaporating vessel which as shown is of the vertical type; and *b* is the nest of tubes fixed in upper and lower tube plates *c*, secured in the shell of the vessel *a*, and in the lower portion of the vessel, to the outside surface of which the heating steam is applied; the liquid existing only below and above the nest of tubes *b*, and passing through them.

[This Drawing is a reproduction of the Original on a reduced scale.]



Chapman's Improvements in Liquid Evaporating Apparatus.

d is the steam jet forcing apparatus above referred to, and *e* is the pipe conveying steam of high pressure to it, which serves as the motor or compressing steam.

The head of the steam jet compressor *d* has a perforated case, which will stand above the level of the liquid contained in the vessel *a*; and through the apertures of which the steam to be compressed is introduced, and is forced and compressed by the steam jet in the well-known way.

This diverging discharging tube of the steam jet apparatus is fixed over an aperture in the centre of the upper tube plate *c*, and the steam compressed by it is discharged into the central space of the tube chamber round the tubes; and by the rise of temperature resulting from this compression, say up to that equivalent to 3, 4, or 5 lbs. above atmospheric pressure, or above that existing in the steam space from which it takes its steam in the upper part of the vessel *a*, the heat, both of the steam so compressed and the motor steam, is transferred to the liquid passing or circulating through the tubes *b* and is condensed; and the steam given off or evaporated from the liquor thus heated is again introduced into the steam jet compressor *d*, and is again employed, and so on the steam works continuously.

The steam compressor *d* cannot take all the steam generated in the vessel *a*, and the overplus quantity generated is passed by the pipe *h* to a pre-heater *i* of any known suitable kind, through which the liquid to be evaporated is passed, and so heated; the conduit for the liquor to the pre-heater, and from the pre-heater to the bottom chamber of the vessel *a*, being marked *k* and *l*, respectively.

In evaporating sea-water for making fresh water from sea water, in cases where the differences of pressure between the heating steam and the liquid being evaporated are small, it is necessary, in order that the apparatus and system may work properly, that the liquid, say, salt water, is not concentrated beyond a certain amount, and therefore, a certain quantity has to be continuously discharged, and this quantity in such a case is large.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:—

The apparatus for evaporating liquids particularly as set forth with reference to and shown in the accompanying drawings, namely, a vertical cylindrical apparatus having between lower and upper portions, serving respectively as liquid, and liquid and steam chambers, a chamber of the same diameter as these lower and upper vessels, and separating them, and lower and upper tube plates *c* extending across the apparatus and fitting between the casing of the lower liquid chamber and the casing of the steam chamber, and also between the casing of the steam chamber and the casing of the liquid and steam chamber, respectively; a steam jet compressor fixed on the upper tube plate *c*, and having its head within the steam space of the upper chamber, to which the steam of high pressure is conducted by the pipe *e* extending through this chamber; and vertical heating tubes *b* fixed in the upper and lower tube plates *c*, all as herein set forth and shown.

Dated this 22nd day of January, 1914.

E. R. ROYSTON & Co.,
Applicant's Patent Agents,
Tower Building, Water Street, Liverpool, and
Donington House, Norfolk Street, London, W.C.

Reference has been directed in pursuance of Section 7, Sub-section 4, of the Patents and Designs Act, 1907, to Specification No. 2967, of 1878.